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Research Article

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Body Mass Index of selected Overweight and Obese Indian Adolescents in Madurai district, Tamil Nadu, India

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Abstract: Childhood obesity is an important predisposing factor for most non-communicable diseases. Irrespective of the age and gender, the prevalence rates of overweight and obesity has attained alarming levels not only in developed countries but also in developing countries among all socio-economic groups. The prevalence of overweight and obesity has reached alarming levels, affecting virtually both developed and developing countries of all socio-economic groups, irrespective of their age and gender. Hence, the present study was aimed to identify the anthropometric measurements of selected overweight and obese school-going adolescents from different schools from Madurai district Tamil Nadu, India. A total of 514 adolescents (312 Girls and 202 Boys) aged 13-18 years participated from government and private schools. Mean height, weight and BMI were calculated and compared with (National centre for Health Statistics) NCHS standard references. The mean height, weight and BMI were found to be increasing as the age increases of both genders. Body Mass Index of Girls (34.18 – 35.24)was found to be higher than boys (33.49 – 32.89) of the same age group. The School-going adolescents of both genders, in general, have short stature at all ages as compared to NCHS reference data. The prevalence of Overweight 95 (18.48%) and obese 315 (61.28%) was found to be higher in Nuclear families, but there was no statistical association between family type and BMI ($X2 = 2.575$, $p > .05$). A significant relationship was found between the Body Mass Index of the adolescents and Father's Educational qualification (p=.00) and Mother's Occupation (p=.008). Nutrition education can play an important part in reducing the incidence of overweight/obesity and its associated complications.Extensive trials with a healthy school environment as an intervention may pave the way for developing new strategies to reduce the overweight and obesity in school-going adolescents.

Keywords: Body Mass Index- BMI, Overweight, Obese, Adolescents, Height and Weight.

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1. INTRODUCTION

Adolescence is characterized by rapid physical growth and sexual development, accompanied by changes in the percentage of body fat. Childhood and adolescent obesity have been identified as a risk factor for obesity in adulthood, and it increases adult morbidity and mortality by leading to a variety of adverse health outcomes[1, 2] .The anthropometric assessment of adolescents is an essential factor not only as an indicator of nutritional status but also predicts numerous health issues, comorbidities, and their quality of life[3].Height and weight are important anthropometric values because of their role in calculating body mass index (BMI), a measure of overweight and obesity[4]. The practice of body mass index (BMI) for age to define nutritional status in adolescents is well established for both clinical and public health applications, because of their feasibility under clinical settings and in epidemiological studies. The Body mass index of growing children and adolescents increases along with age, hence it is mandatory to use age-gender-specific thresholds[5].Since adolescence is a phase of transition from childhood to adulthood, the changes in lifestyle and dietary patterns result in an increased prevalence of overweight and obesity[3]. In adolescence, obesity is likely to be associated with various psychological consequences. Apart from the physical risks, overweight children can exhibit emotional ramifications secondary to ridicule and labelling by their peers, including lower levels of self-esteem. Obesity is associated with several risk factors for heart disease and other chronic diseases in adult life, including hyperlipidaemia, hyperinsulinemia, hypertension and early atherosclerosis[6]. Obesity is an important factor contributing to the morbidity and mortality rates due to chronic non-communicable diseases[7].According to WHO (2020), around 340 million school-going children and adolescents belonging to the age group of 5-19 years were neither overweight nor obese in 2016. The prevalence of overweight and obesity among school-going children and adolescents belonging to the 5-19 years age group has risen intensely from just 4% in 1975 to over 18% in 2016. The upsurge has arisen similarly among both the genders: in 2016, 18% of girls and 19% of boys were overweight. India is facing a "twin epidemic" in the form of under- and over nutrition in children and adolescents. Over-nutrition to insulin resistance, metabolic syndrome, and type 2 diabetes mellitus (T2DM). Increasing prevalence of obesity and insulin resistance has been reported in Asian Indian adolescents [8].Ascertainment of the age at which obesity develops and determination of whether there are specific critical periods in childhood and adolescence that are characterized by accelerated and sustained weight gain are thus important and may aid in the development of effective preventive strategies [9].During adolescence, the social environment diversifies and extra familial influences progressively become more important references. In this period, children are more independent, start making their own food choices and take personal decisions regarding what they eat. The family is less important for adolescents, while friends, peers and social models are the key influences on their eating practices[10]. Even though adolescent health is one of the important factors on the community, researchers have not paid much attention to analysing the nutritional and growth status of overweight and obese adolescent population of India. This study is an attempt to identify the growth pattern of overweight and obese adolescents for a better understanding of their nutritional requirements.

2. MATERIALS AND METHODS

A cross-sectional study was conducted with 514 school-going adolescents (Boys = 202, Girls = 312) aged 13-18 years belonging to Madurai District, Tamil Nadu. Random sampling technique was utilized to identify the overweight and obese adolescents from various schools during the period of July to December 2018Before examining and retrieving data, students were requested to fill out the identity sheet and sign a letter of approval to become a research participant. A pre-tested, Semi-Structured and validated questionnaire was provided in both English and local language-Tamil. The required information such as age, gender was elicited through direct interview method and the answers were filled in on the available questionnaire sheets[11]. An initial pilot study was undertaken with 10 informants; the questionnaire and its components were discussed with the informants to determine whether they found any aspect of the questionnaire difficult. After minor corrections, the final questionnaire was ready to conduct the study. Bodyweight was measured (to the nearest 0.5 kg) with the student standing motionless on the digital weighing scale with feet apart, and weight equally distributed on each leg. Height of the study population was measured (to the nearest 0.5 cm) making the student to stand straight erect on a vertical scale and with the head positioned so that the top of the external auditory meatus was on a level with the inferior margin of the bony orbit. Body mass index (BMI) was calculated as weight in kilograms/ (height in meter)^2[12]. Since BMI values are sensitive to changes in fat distribution and the development of muscle during puberty, we calculated and used a BMI z-score for each student's age within the 2- year spread in the age of our study population[13].A child was identified as underweight when Body Mass Index was found to be ≤ Fifth Percentile with regard to age and gender. A child was considered as overweight when Body Mass Index surpassed the eighty-fifth percentile with regard to age andgender. A child was identified as obese when Body Mass Index was found to be ≥the ninety-fifth percentile with reference to age and gender. For labelling a child as underweight, normal, overweight or obese, the frequencies of BMI cut offs relative to the National Centre for Health Statistics (NCHS)/World Health Organization (WHO) reference data (CDC Charts)[14] were used.

3. STATISTICAL ANALYSIS

The collected data was coded and interpreted using SPSS Software Version 19.0. Data were analysed using descriptive tests, a chi-square correlation test ($p < 0.05$), and independent different test t-test samples ($p < 0.05$). The Chi-square analysis was done to find the association between gender and BMI, while an independent sample t-test was used to identify the mean differences between weight, height, and BMI of adolescent boys and girls.

4. RESULTS

4.1 Sociodemographic Characteristics

Of the 514 respondents, 310 (60.3%) were Girls while 204 (39.7%) were Boys. Even though both genders were fairly represented in the study, Majority of them were females. Table 1 represents the Socio-demographic Information of the school going students and their Body Mass Index. Among all religions, obesity (66.73 %) and overweight (20.81 %) were

found to be more among Hindus. The proportion of students who reported being overweight and obese did not differ by religion ($X2 = 2.779$, $p > .05$). Overweight 95 (18.48%) and obese 315(61.28%) students were seen more in Nuclear families, but there was no statistical association between family type and BMI ($X2 = 2.575$, $p > .05$). The rate of overweight (10.7%) and obesity (20.8%) was higher in students whose father had a post-high school Diploma level of education. There is a significant relationship between Fathers' educational qualification and Body mass Index of the children (p=0.00). In Contrast, the prevalence of overweight (10.7%) and Obesity (23.15%) was found in students whose mother had high school Diploma level of education and it is not statistically significant with Body mass Index of the children (p=.057).Among the studied population, 69 (13.42%) Overweight and 226 (43.96%) Obese students' father were unskilled workers. No statistical significance was found between the fathers' occupation and BMI of the Children. Among all, 83 (16.14%) overweight and 305 (59.33%) obese students' mothers were Housewife. There was a significant association between a mother's occupation and Body Mass Index of the children (p = 0.008; Table 1). Higher rates of obesity (44.74%) and overweight (13.61%) were seen in children with lesser family income compared to children belonging to parents with higher family income (obese, 7.19 %; overweight (2.33%). No statistically significant association was found between the Family income and BMI (p = .618; Table 1).

Table 1. Socio-demographic characteristics of the students and their comparison with Body Mass Index.

Variables	Body Mass Index			
	Overweight (%)	Obesity (%)	Total (%)	p-value
Religion				
Hindu	107 (20.81%)	343 (66.73%)	450 (87.54%)	χ^2= 2.779 df=2 p = .24
Christian	4 (0.77%)	14 (2.72%)	18 (3.49%)	
Muslim	16 (3.11%)	30 (5.86%)	46 (8.97%)	
Family Type				
Nuclear	95 (18.48%)	315 (61.28%)	410 (79.78%)	χ^2= 2.575 df=1 p = .10
Joint	32 (6.22%)	72 (14 %)	104 (20.22%)	
Father's Education				
Illiterate	15 (2.91%)	77 (14.98%)	92 (17.89%)	
Primary School	14 (2.72%)	82 (15.95%)	96 (18.67%)	χ^2= 16.423 df=4 p = .002#
High School	22 (4.28%)	62 (12.06%)	84 (16.34%)	
Post High School Diploma	55 (10.7%)	107 (20.8%)	162 (31.51%)	
Graduate (or) Post Graduate	21 (4.08%)	59 (11.47%)	80 (15.56%)	
Professional Degree	-	-	-	
Mother's Education				
Illiterate	18 (3.5%)	78 (15.17%)	96 (18.67%)	
Primary School	14 (2.72 %)	57 (11.08%)	71 (13.81%)	
High School	19 (3.69%)	79 (15.36%)	98 (19.06%)	χ^2= 9.165 df=4 p = .057
Post High School Diploma	55 (10.7%)	119 (23.15%)	174 (33.85%)	
Graduate (or) Post Graduate	21 (4.08%)	54 (10.5%)	75 (14.59%)	
Professional Degree	-	-	-	
Father's Occupation				
Unskilled Worker	69 (13.42%)	226 (43.96%)	295 (57.39%)	
Semi-Skilled Worker	33 (6.42%)	87 (16.92%)	120 (23.34%)	
Skilled Worker	12 (2.33%)	28 (5.44%)	40 (7.78%)	χ^2= 3.351 df=5 p = .64
Clerical, Shop Owner	-	4 (0.77%)	4 (0.77%)	
Semi-Professional	12 (2.33%)	35 (6.80%)	47 (9.14%)	
Professional (White Collar)	1 (0.19%)	7 (1.36%)	8 (1.55%)	
Mother's Occupation				
House Wife	83 (16.14%)	305 (59.33%)	388 (75.48%)	
Semi-Skilled Worker	18 (3.5%)	24 (4.66%)	42 (8.17%)	
Skilled Worker	6 (1.16%)	14 (2.72%)	20 (3.89%))	χ^2= 13.743 df=4 p = .008#
Clerical, Shop Owner	-	4 (0.77%)	4 (0.77%)	
Semi-Professional	20 (3.89%)	40 (7.78%)	60 (11.67%)	
Professional (White Collar)	-	-	-	
Family Income				
<Rs.7887-13,160	70 (13.61%)	230 (44.74%)	300 (58.36%)	
Rs.13,161-19,758	33 (6.42%)	88 (17.12%)	121 (23.54%)	
Rs.19,759-26,354	12 (2.33%)	28 (5.44%)	40 (7.78%)	χ^2= 2.649 df=4 p = .618
Rs.26,355-52,733	-	4 (0.77%)	4 (0.77%)	
>Rs.52,734	12 (2.33%)	37 (7.19%)	49 (9.53%)	

Christian and other religions merged when χ^2-test applied.*Mothers occupation service and business merged when χ^2-test applied#P value significant at 5% level.

4.2 Comparison of Mean Height with NCHS Standards

The age-wise mean height of School-going adolescents of both genders was compared with NCHS (National centre for Health Statistics) data as shown in Figure 1. It was noted that the mean height was found to be increasing as the age increases of both genders.

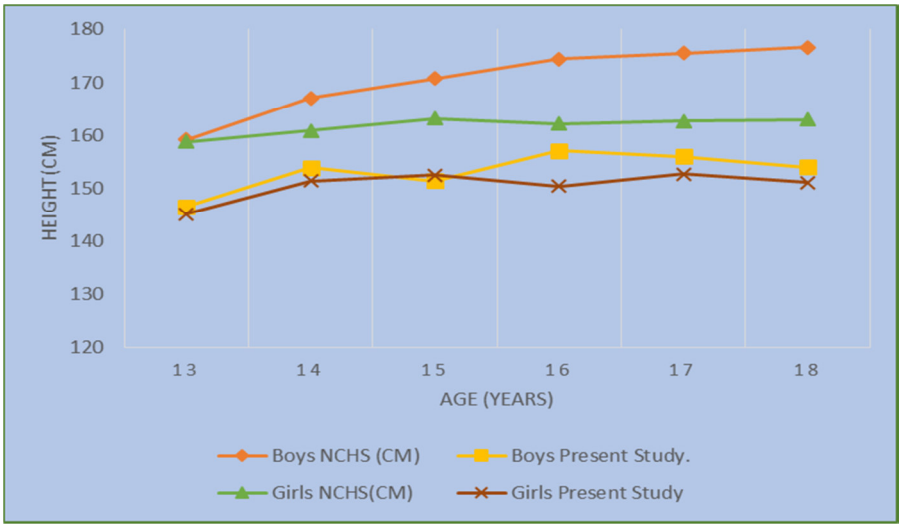

Fig 1: Age-wise mean height of School-going adolescents of both gender and their comparison and difference with NCHS reference data

Mean height of the School-going adolescents of both the genders were found to be lesser than that of NCHS Standard (2002). NCHS Standard reference values ranged from 159.2 to 176.6 for 13-18 years old adolescent boys whereas the present study adolescent boys height ranged only between 146.53 to 154. Similarly, NCHS Standard reference values ranged from 158.8 to 163 for 13-18 years old adolescent girls whereas the present study adolescent girls height ranged only between 145.18 to 151.13. Hence, it can be concluded that the School-going adolescents of both genders, in general, have short stature at all ages as compared to NCHS reference data.

4.3 Comparison of Mean Weight with NCHS Standards

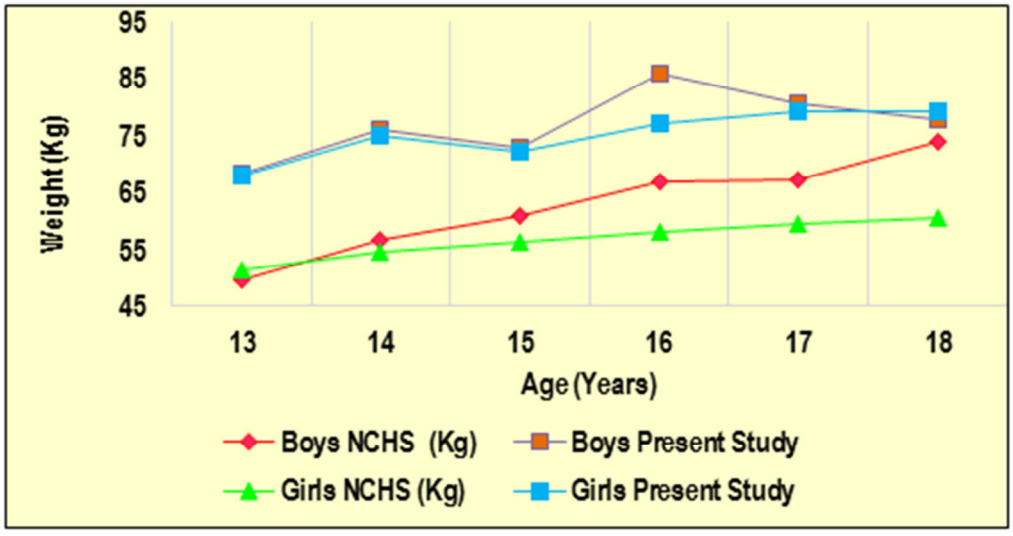

Fig 2: Age-wise mean weight of School-going adolescents of both gender and their comparison and difference with NCHS reference data.

The above figure 2 depicts that the mean weight of the School-going adolescents was high when compared to that of NCHS Value. The mean weight of both obese and overweight children was above normal, among all the age groups and both boys and girls. The findings of the study revealed that the mean weight of overweight and obese children increased with age. The increase in weight and ultimately obesity may be associated with the increase in adipose tissue and the pubertal growth spurt.

4.4 Mean BMI

Table 2. Age-wise mean BMI of School-going adolescents

Age (Years)	Boys		Girls	
	Overweight (≥85th-<95th percentile)	Obese (≥95th percentile)	Overweight (≥85th-<95th percentile)	Obese(≥95th percentile)
13	27.436±1.59	33.498±3.37	28.145±1.85	34.189±3.19
14	29.412±0.413	33.21±3.78	28.31±1.4	34.07±2.68
15	28.19±1.32	32.92±2.33	28.44±0.85	33.60±2.04
16	26.34±0.42	36.62±10.33	29.40±0.0	35.90±0.75
17	28.0±0.0	33.52±1.31	28.63±0.85	35.43±3.59
18	-	32.89±0.0	29.13±0.72	35.24±2.95

All values are represented as mean±S.D.

Mean BMI of school-going adolescents was compared with WHO (World health organization) data as shown in Table 2. From the above Table, it is evident that the BMI of adolescents is constantly increasing as age increases. In this study, Table 2 shows that Girls had a higher BMI while compared with boys of the same age. The Body Mass Index of selected overweight and obese adolescents was significantly higher than CDC (2000) standard values. The BMI of the selected overweight boys was in the range of 27.43 - 28 and girls in the range of 28.14 – 29.13. The BMI of the selected obese boys was in the range of 33.49 – 32.89 and girls in the range of 34.18 – 35.24.

5. DISCUSSION

In this study, the prevalence of Overweight 95 (18.48%) and obese 315 (61.28%) was found to be higher in Nuclear families, but there was no statistical association between family type and BMI ($X2 = 2.575$, $p > .05$). As shown by the National Family Health Survey (NFHS-III)[15] Report, three of five households in India are nuclear. The household structure shows that the proportion of nuclear households is higher in urban areas (63%). Similarly, rates of approximately 67.6% nuclear and 32.4% of joint families were reported by Bharatiet al[16]. In a study conducted by Keerthan et al.[6], no significant association was found between the type of family and obesity, but the percentage of overweight (3.11%) and obesity (4.15%) was very higher in adolescents residing in the nuclear family than joint family (1.89% and 1.42%).In this study, the prevalence of overweight (10.7%) and obesity (20.8%) was higher in students whose father had post-high school Diploma level of education and it is statistically significant with Body mass Index of the children (p=0.00). Contrarily, the prevalence of overweight (10.7%) and Obesity (23.15%) was found in students whose mother had high school Diploma level of education and it is not statistically significant with Body mass Index of the children (p=.057). There was no significant association between fathers' occupation and overweight and obesity of the children (p = .64), but, There was a strong association between mothers' occupation and overweight and obesity of the children (p = .008; Table 2). Similar findings were reported by Laxmaiahet al.[17] that prevalence of overweight was significantly higher ($p < 0.05$) among the adolescents whose parents' occupation was either service (9.1%) or business (7.4%) than other occupations (3.1%). Bharati et al.[16] found that the risk of overweight/obesity was significantly higher among children whose father and mother had more education than the sixth standard, and children whose fathers were service/businessmen. Similarly, Adesinaet al.[18] found that the percentage of overweight subjects whose mothers were highly educated was higher (9.7%). These findings were also supported by Majeed et al.[19] show that the highest percentage of the study girls were the offspring of highly educated (college and more) mothers (46.86%). Though, high percentages (72.6%) of the study population reported their mothers to be housewives. In the present study, the mean height was found to be increasing as the age increase of both genders. Mean height of the School-going adolescents of both the genders were found to be lesser than that of NCHS Standard (2002). The results of our study coincide with the study of Prashant & Chandan[20] in the urban slum of Dhaka, who reported that 65% of the obese girls (10 to 18 years) were shorter (< 3rd percentile of NCHS reference values). This result was not on par with Sharma et al[7]., who indicated that both overweight boys and girls were taller when compared with NCHS data to the corresponding age group. H. Mullick[21], S.Khali & Z. Khan[22] and Semwalet al[23] in their study also reported findings similar to this present study. Results of the present study were similar with the study conducted by Kowsalya T, Parimalavalli R[24] who reported that the mean weight of the obese adolescents (10-17years) was higher when compared to the NCHS standard value.

6. CONCLUSION

The present findings indicate that the mean anthropometric measurements of overweight and obese adolescents were significantly increased with the age irrespective of their gender. BMI was highly influenced by weight followed by age and height. Childhood and adolescence is a vital period of growth in humans and it presents numerous opportunities for health promotion interventions since various eating habits, lifestyle and behaviour patterns are established that persist throughout adulthood. The school environment offers a great possibility to reach large numbers of the population, including young people and school staff as well as families and community members. Hence, health messages learnt in school can be maintained and pursued by children at home and in their surroundings. Nutrition education to lead a disease-free healthy life is mandatory on the school level.

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8. AUTHOR CONTRIBUTION STATEMENT

Dr. S. Parameshwari derived the concept, guided this study and revised the manuscript. Ms.B. Bhuvaneshwari carried out the research study, evaluated the results, drafted the

manuscript, contributed to the design, implementation of the research to the analysis of the results and the writing of the manuscript. We declare that all of the authors mentioned in the article have contributed equal efforts in this research and also for the submission of the article.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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